WARZYN

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June 11, 1992

Mr. Wayde M. Hartwick, RPM
Mailcode HSRL-6J
Waste Management Division
Office of Superfund
IL/IN Remedial Response Branch
U.S. Environmental Protection Agency
Region V
77 West Jackson Boulevard
Chicago, Illinois 60604

Re: Revisions-Final Report
ACS Feasibility Study
Griffith, Indiana

Dear Mr. Hartwick:

Enclosed are copies of the proposed revisions of the Final Feasibility Study Report for the ACS Site in Griffith, Indiana. The changes are shown in "red-line" format for convenience of review. The report incorporates U.S. EPA comments discussed over the last few months. When the changes are approved by you, Warzyn will submit complete copies of the Final Feasibility Study Report to you incorporating the changes as approved.

If you have any questions, please give me a call at (708) 691-5020.

Sincerely,

WARZYN INC.

Craig W. Baker for

Joseph D. Adams Jr., P.E.
Vice President

Enclosures: As stated

cc: Andy Perillis - PRP Steering Committee

THE PERFECT BALANCE BETWEEN TECHNOLOGY AND CREATIVITY

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It is emphasized that the risk factors developed in the Baseline Risk assessment may not represent the actual risks at the Site. The calculated risks are only applicable to the extent that the exposure scenario is recognized. For instance, although the baseline risk assessment calculates risk for ingestion of contaminated groundwater, there are no current groundwater users that have been impacted by the Site.

The following sections provide a general summary of the results of the baseline risk assessment. Detailed results and interpretations are presented in the Baseline Risk Assessment, Volumes 1, **2 and 3 September 1991.**

The Baseline Risk assessment was performed consistent with the Risk Assessment Guidance for Superfund (RAGS, U.S. EPA 1989) in coordination with the U.S. EPA RPM and Technical Support Group.

1.6.1 Uncertainties in the Risk Assessment Process

The risk assessment process incorporates numerous assumptions and is therefore associated with some degree of uncertainty. Calculated risk estimates are based upon reasonable worst case scenarios, and may or may not be realized at the Site. Proper interpretation of health risk values requires consideration of the uncertainties and assumptions involved in the risk assessment calculations. In addition, the risk assessment uses hypothetical scenarios and conservative assumptions to quantify potential risks for current and future land uses which may or may not reflect actual risks.

1.6.2 Quantification of Potential Risk

Non-cancer health effect risks were estimated by calculation of hazard quotients (HQ). For a given exposure pathway, the hazard quotients for all chemicals of concern are added to arrive at a total. This total value is referred to as the hazard index (HI) for the exposure pathway. A HI or HQ in excess of unity (1) may represent a potential health risk associated with exposure via a particular pathway or chemical.

The cancer risk value is an estimate of an individual's lifetime likelihood of developing cancer over and above the existing background chance of developing cancer. A cancer risk of 1 x 10^{-6}, for example, may be interpreted as an increased risk of one in one million of developing cancer over a person's lifetime. This risk may also be interpreted on a population basis, to predict that one additional case of cancer may occur in a population of one million people. For known or suspected carcinogens, the 1 x 10^{-6} risk level is used by U.S. EPA as a "point of departure". Cancer risks which are between 1 x 10^{-6} and 1 x 10^{-4} may or may not warrant remediation, depending on other risk management factors.

1.6.3 Potential Health Risks Based on Current Land Use

The current land use scenario is a reasonable worst case situation that could occur if the Site is left unchecked and unremediated with no action taken to minimize any migration from, or direct exposure to, contaminants at the Site. Current land use health risks associated with exposure to contaminated Site media were evaluated for off-Site residents, trespassers, and on-Site workers at the ACS facility. The assumed degree of exposure to populations from the pathways in the risk assessment is based upon common assumptions which probably result in risk assessments that are conservative.

Off-Site residents were considered to be exposed to contaminants released to groundwater and air under current land use conditions. Although these exposures were created hypothetically for this report, it is not inconceivable that these conditions may be realized in the future given current land use conditions. Risk to adults and children was considered separately, as was exposure to groundwater from the lower and upper aquifers. Risks to off-Site residents which might occur if off-Site residents were actually exposed under this scenario included:

- A non-cancer hazard index (HI) greater than 1 for children **primarily** as a result of dermal exposure to ~~2-butanone~~**4-methyl-2 pentanone (54% of the risk).**

- A total cancer risk to children exposed to groundwater from the upper aquifer of ~~4.9~~**1.7** x 10^{-2}, attributed mainly to dermal exposure to benzene.

- A total pathway HI for off-Site residents exposed to contaminants in air and groundwater of ~~1.8~~**2.1**.
- A total cancer risk for off-Site adults of ~~6.6~~**4.5** x 10^{-4}, attributable mainly to ingestion of arsenic and bis(2-chloroethyl) ether from groundwater.

Site trespassers were assumed to be exposed to contaminants from surface soils, surface water, sediments, and fugitive dusts and volatiles. Quantified risks for this scenario included:

- A total HI for all pathways of ~~1.5×10^{2}~~ $\mathbf{1.9 \times 10^{+1}}$, due mainly to ingestion and dermal absorption of surface soils at Kapica-Pazmey.
- A total cancer risk for all pathways of 6.3 x 10^{-3}, attributed mainly to dermal contact with benzene, inhalation of volatiles, and exposure to PCBs.

ACS facility workers were assumed to be exposed hypothetically via inhalation of fugitive dusts from Kapica-Pazmey and volatiles released from buried waste. Risks for this hypothetical scenario included:

- A HI of ~~3.2~~**9.9**, due mainly to VOC emissions from buried wastes.
- A cancer risk of 1.6 x 10^{-3}, due mainly to inhalation of VOCs (primarily 1,1-dichlorethene, chloroform, and carbon tetrachloride).

<u>1.6.4 Potential Health Risks Based On Future Land Use</u>

Future land-use health risks were based on exposure to contaminated Site media by residents living on-Site. This is assumed to be the reasonable worst case scenario. Residents were assumed to be exposed to soils at specific parts of the Site independent of the other areas, e.g., the Off-Site Containment area exclusively. The only difference in risk associated with each specific portion of the Site came from soil exposure, since exposure to groundwater and surface water was assumed to be the same throughout the Site. Risks associated with this future land use scenario included:

- The non-cancer hazard index for exposure to contaminated groundwater from the upper aquifer was estimated at ~~2.4×10^{3}~~ $\mathbf{3.3 \times 10^{+2}}$, due primarily to dermal exposure to 2-butanone. The cancer risk was approximately ~~1.4×10^{-1}~~ $\mathbf{8.7 \times 10^{-2}}$, due mainly to benzene exposure.

- The non-cancer hazard quotients for surface water ~~(2.2)~~ and sediments ~~(2.0)~~ ~~were attributed primarily to dermal exposure to 2-butanone~~ **are less than unity.** The cancer risk due to surface water exposure was 1.~~1~~**6** x 10^{-4}, attributed mainly to dermal exposure to ~~benzene~~**PCBs.** Sediment cancer risk was 2.2 x 10^{-4}, as a result of exposure to carcinogenic PAHs and PCBs.

- The non-cancer hazard index for inhalation of VOCs was ~~5.3~~**1.6 x 10^{+1}**, due primarily to exposure to n-chain alkanes. The cancer hazard risk was 2.7 x 10^{-3}, as a result of possible exposure to 1,1-dichloroethene, ~~1,1,1-trichloroethane,~~**carbon tetrachloride,** and chloroform.

- Non-cancer **HI values in excess of unity** and cancer **risk estimates** ~~HI values in excess of unity~~ associated with exposure to soils in the various Site areas were due to the presence of various volatile organics and metals. Among the chemicals of concern were tetrachloroethene, PCBs, carbon tetrachloride, and PAHs.

- The **non-cancer hazard quotient and** cancer risk appeared greatest for a resident residing at the Off-Site Containment Area ~~(2.9 x 10^{-1})~~**(1.0 x 10^{+3} and 1.5 x 10^{-1}, respectively).**

1.6.5 Summary of Ecological Assessment

~~The ACS Site includes some natural habitat as well as industrial properties. Although there is limited open surface water habitat, there are wetlands on the Site and in the Site area. Terrestrial areas support mature oak forests in undeveloped areas.~~

~~Chemicals of potential ecological concern at the ACS Site include TCL compounds and TAL metals found in the Site surface waters, sediments, and soils. Most organic compounds are not readily absorbed by aquatic and wetland plant species. Because habitat for aquatic fauna is limited, organic compounds do not likely present an appreciable source of hazard to Site open water or wetland habitats. Some metals found in Site surface waters exceeded U.S. EPA Ambient Water Quality Criteria and may present an environmental concern. Although sediment samples were below background levels for soils for TAL metals, derived sediment quality criteria could not be developed~~

~~for assessment of ecological effects of nonpolar organic compounds. Sediment quality criteria will be developed and discussed when TOC data become available.~~

~~The health of most of the flora in the undeveloped Site areas did not appear stressed by chemical contamination, based on the observed density of aquatic, wetland, and terrestrial vegetation. The area on the northern side of the ACS plant property appeared to show signs (lack of vegetation) of some localized chemical stress.~~

Warzyn completed a draft of an ecological assessment for the site. U.S. EPA commented on the draft, but consensus could not be reached on resolution of the comments. Therefore, a consultant for the U.S. EPA prepared the final ecological assessment for the Site under U.S. EPA direction. The results of the ecological assessment performed by the U.S. EPA indicate that there may be possible ecological risks at the Site based on conservative worst case assumptions, but they are difficult to quantify. The U.S. EPA ecological assessment shows that:

- **Contaminants of potential ecological concern in water at the ACS Site may include lead, iron, zinc, cadmium, mercury, cyanide, PCBs, chlorobenzene, benzene, diethyl phthalate, and bis (2-ethylhexyl) phthalate.**
- **Contaminants of potential ecological concern in soils and sediments at the ACS Site may include arsenic, cadmium, chromium, copper, lead, mercury, zinc, PCBs, benzene, toluene, ethylbenzene, xylene, bis (2-ethylhexyl) phthalate, heptachlor epoxide and PAHs.**
- **The major risk to burrowing rodents appears to be from exposure to PCBs resulting from potential exposure to browse grown in contaminated soil and incidental ingestion of contaminated sediments.**
- **Upland, wetland, and aquatic receptors may be adversely affected by contaminants present in the environmental media within the ACS Site watershed. The contaminants posing the greatest ecological risk include PCBs and lead. In addition, various metals, bis (2-ethylhexyl) phthalate and heptachlor epoxide pose a potential risk to aquatic receptors and mink.[1]**

1. Mink have not been observed in the area.

SECTION 4.0
DETAILED ANALYSIS OF ALTERNATIVES

4.1 Approach to Detailed Analysis

4.1.1 Introduction

Final alternatives for detailed analysis were selected in Section 3.7. This section presents site specific descriptions and a detailed analysis of the remedial action alternatives which were retained during the preliminary screening process. Section ~~4.2~~4.1.2 presents the nine evaluation criteria used to perform the detailed analysis of alternatives; and Sections ~~4.3~~4.2 and ~~4.4~~4.3 consist of the evaluation and presentation of information for each alternative relevant to the selection of a Site remedy. This approach to analyzing alternatives will provide sufficient information to adequately compare alternatives, select an appropriate Site remedy and demonstrate satisfaction of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) remedy selection requirements in the Record of Decision. The initial alternatives discussed involve containment remedies, while the later alternatives involve treatment remedies. The references used in Section 4.0 to evaluate process options and develop cost estimates are presented in the bibliography in Appendix D.

Various independent and medium specific process options which are applicable to more than one of the final alternatives were retained for detailed analysis. Detailed analyses of these independent and medium-specific process options are presented in Section ~~4.3~~4.2, which are separate from the detailed analyses of alternatives presented in Section ~~4.4~~4.3. Independent and medium-specific process options discussed in Section ~~4.3~~4.2 include groundwater extraction/collection, groundwater vertical barriers, treated water discharge, buried waste and soil access restrictions and containment, groundwater and surface water remedial technologies, thermal treatment of buried waste and soils, and biological treatment of buried waste and soils. Only potentially relevant criteria used to differentiate the process options included in more than one alternative were addressed in the detailed analyses of independent and medium-specific process options. Criteria not addressed in the detailed analyses of independent and medium-specific process options are included in the detailed analyses of applicable alternatives.

Implementability

A discussion of implementability is presented in Section 4.2.8 for on-Site thermal treatment and incineration. A RCRA Part B treatment permit would not be required for operation of the thermal treatment unit since this is a CERCLA Site. IDEM air emission ARARs would have to be met in order to construct and operate the thermal treatment unit. Appropriate approvals and/or permits would have to be obtained in order to discharge treated groundwater. Tank farms located on top of the Still Bottoms and Treatment Lagoon Areas would either have to be dismantled or relocated before excavation could begin in those areas. Utility lines and product and water lines are also located in the area of the tank farms. These lines would either have to be moved or replaced. The continuation of ACS's chemical manufacturing operations could interfere with excavation and material handling activities. An access road and entrance road to the Site, both adjacent to the On-Site Containment Areas, may be blocked by excavation activities. Temporary access roads may have to be constructed. A full time shift of workers would have to be present on-Site to operate the thermal treatment system on a 24-hour basis. If infiltration basins are used in each of the source areas to use reinjected groundwater to flush contaminants from the unsaturated zone, they would have to be constructed over very large surface areas. Because of the significant surface areas to be covered, the construction of infiltration basins over each of the source areas may not prove either feasible or practical.

Cost - Capital, annual O&M and net present worth costs are presented in Table 4-15 and Appendix B. Design assumptions for purposes of the cost estimates are presented in Figures 4-12, 4-13 and 4-14 and the itemized cost estimates for Alternatives 3A and 3B presented in Appendix B.

4.3.4 Alternative 4 - In-Situ Steam Stripping of Buried Waste, Soils and Groundwater; Groundwater Pumping and Treatment; and Treated Water Discharge to Wetlands

Description

PCB-contaminated surficial soils (i.e., depths of 0 to 3 feet) exceeding 50 ppm total PCBs would ~~either~~ be ~~treated~~**immobilized** in-situ **by natural attenuation process or fixation techniques** or excavated for off-Site landfilling. In-situ steam stripping would be used to centralized steam supply system would likely have to be constructed. Soil and groundwater sampling would have to be performed at the completion of in-situ steam stripping to verify its effectiveness.

Two significant concerns with steam stripping are the potential for penetrating the clay confining layer and the large volume of soil that would have to be treated if the system does not work.

Treatability and pilot studies would be required if in-situ fixation is required for soils and sediments following in-situ steam stripping treatment.

Cost - Capital, annual O&M and net present worth costs are presented in Table 4-16 and Appendix B. Design assumptions for purposes of the cost estimate are presented in Figure 4-18 and itemized cost estimate for Alternative 4 presented in Appendix B.

4.3.5 Alternative 5 - Off-Site Incineration of Buried Drums; Off-Site Disposal of Miscellaneous Debris; In-Situ Vapor Extraction of Buried Waste and Soils; Groundwater Pumping and Treatment; and Treated Water Discharge to Wetlands

Description

The Site would be dewatered using an extraction system described in Section 4.2.3 so that intact buried drums and miscellaneous debris can be excavated. Intact buried drums in the On-site Containment Area and miscellaneous debris would be excavated prior to installation of the vapor extraction treatment system. Intact drums would be incinerated off-Site and miscellaneous debris would be landfilled off-Site. PCB-contaminated surficial soils (i.e., depths of 0 to 3 feet) exceeding 50 ppm total PCBs would ~~either~~ be ~~treated~~**immobilized** in-situ **by natural attentuation processes or fixation techniques** or excavated for off-Site landfilling. Initially, a groundwater pumping and treatment system would operate at 200 gpm to lower the water level at the Site to elevation 725. Once the groundwater level is lowered across the Site, the pumping rate would be reduced to about 80 gpm to maintain the lowered level. Additional wells would be installed around the waste areas to lower the water level to the top of the clay confining layer.

An in-situ vapor extraction system would be installed in order to treat both soils and buried waste. **Partial installation of a vapor extraction system could begin following the completion of Site dewatering in areas which are not impacted by buried drum excavation activities.** Refer to Sections 4.1.2 and 4.3.6 for a discussion of the criteria used to delineate areas and depths of soils and buried waste requiring treatment. Approximately 135,000 cubic yards (200,000 tons) of soils and buried waste would require vapor extraction treatment. A delineation of areas requiring vapor extraction treatment is presented in Figures 4-1 and 4-2. A uniform depth of buried waste, PCB and VOC presence using surface areas depicted in Figures 4-1 and 4-2 was not assumed in the calculation of total volume requiring treatment. The depth requiring treatment for each cross-sectional area was assumed to be the maximum depth meeting either the buried waste or VOC- or PCB-contaminated soils criteria based on sampling intervals used during the RI. Cross-sectional drawings delineating defined areas of buried waste and VOC- and PCB-contaminated soils at depth will have to be prepared during the final design.

Because of the large waste and soil volumes requiring treatment, and the significant distances between each of the areas, it has been assumed for cost estimating purposes that four separate vapor extraction systems would be installed. Separate systems would be located in the On-Site Containment Area, the Still Bottoms/Treatment Lagoon Areas, the Off-Site Containment Area and the Kapica-Pazmey Area. Figure 4-15 presents a layout of the proposed extraction system, while Figure 4-16 presents a schematic process flow diagram and preliminary design information for a vapor extraction system.

Design parameters presented in the case study for the Verona Well Field Superfund Site (Verona Site) located in Battle Creek, Michigan (U.S. EPA, July 1989) serve as the basis for the treatment time frame estimate and extraction well spacings for the ACS Site. The soil conditions and VOC contaminant matrix at the Verona Site were similar to the ACS Site. Maximum individual VOC soil concentrations at the Verona Site ranged up to 1800 ppm (U.S. EPA, July 1989). Approximately 28,000 pounds of VOCs were extracted in 55 days of operation (i.e., an average of approximately 500 pounds/day). Actual design parameters for a vapor extraction system would be determined following the completion of a pilot study.

for adsorbing onto soils, phthalates and PAHs are not expected to migrate either off-Site or to the upper aquifer from wetlands and drainage ditch sediments.

The sediment sample collected from the former drainage system adjacent to the Off-Site Containment Area was the only sample which exceeds the 10 ppm total VOC criteria used to delineate contaminated soils. Sediments from this area would either be excavated for off-Site disposal or treated by vapor extraction since the area will be dewatered. None of the sediment samples exceeded the 50 ppm total PCBs criteria used to delineate PCB-contaminated soils. Only one sample, SB02 taken from the ACS Site, exceeded 10 ppm total PCBs (22 ppm). This area could either have a soil cover placed over it to prevent dermal contact, or excavated for off-Site landfilling or treated in-situ along with other PCB-contaminated soil areas.

A cover could be placed over unpaved surfaces in the areas to be treated in order to prevent the short-circuiting of air from the surface, which reduces the radius of influence of individual extraction wells. A cover would also reduce rainwater infiltration which could adversely impact vapor extraction treatment efficiencies. Either a plastic liner or soil cover could serve this purpose.

The treatment time frame estimate is based on an assumed average VOC soil concentration in the Off-Site Containment Area of 24,000 ppm (2.4%), and an average VOC removal rate between 500 pounds per day and 3500 pounds per day (extrapolated based on the ratio of total VOC concentrations in the Off-Site Containment Area versus the Verona Well Field Superfund Site) for the Off-Site Containment Area only. The Off-Site Containment Area was used as the basis for the treatment time frame calculations since the highest average total VOC concentrations were found in this area. Based on these VOC removal rates, the estimated time frame to complete Alternative 5 is 5 to 20 years.

Groundwater pumping and treatment would be ~~conducted in off-Site areas~~**performed to contain off-Site contaminant migration.** ~~Following removal of the buried waste and their treatment on Site,~~**After dewatering is achieved, buried drums would be excavated and taken off-Site for incineration.** The groundwater pump and treat system would **then** be optimized to determine the most efficient means to remediate the aquifer. Groundwater remediation approaches could include in-situ biological treatment or the placement of injection and withdrawal wells to more aggressively pump and treat the

- Tetrachloroethane was remediated to less than 1 ppm;
- Trichloroethene was remediated to less than 5 ppb;
- Carbon tetrachloride was remediated to below analytical detection limits;
- 99.2% hydrocarbon reduction was achieved for a jet fuel spill; and
- Benzene levels of less than 1 ppb were achieved for one gasoline spill cleanup, while total hydrocarbons were reduced to below analytical detection limits for a second gasoline cleanup.

Based on the case study data presented above, 99%+ removal efficiencies appear to be obtainable for VOCs amenable to vapor extraction. None of the sites presented in the case studies, however, had a contaminant matrix analogous to the ACS Site. Most of the sites had total VOC concentrations less than 1,000 ppm. One site reported maximum VOC concentrations of 5,600 ppm, while one of the sites involving remediation of fuel contamination reported total hydrocarbon levels of 6,200 ppm. VOC removal rates are the highest during initial startup and decrease with time as mass transfer of contaminants into the vapor phase becomes rate limiting. Final removal efficiencies are also a function of the time frame the vapor extraction system is allowed to operate.

Of the chemical groups not expected to be amenable to vapor extraction, phenols were not identified as a target compound group for soils in any of the areas based on the BRA. Phenols, organic acids and isophorone were not identified as target compounds in the upper aquifer. Phthalates, carcinogenic PNAs, PCBs and inorganic metals **are relatively immobile because they** have high soil adsorption coefficients. ~~and~~**They** were not identified as a target compound group in the upper aquifer. If left untreated, phthalates, carcinogenic PNAs, PCBs and inorganic metals would **not** be expected to ~~be immobilized in the soil matrix and not~~ migrate to either the upper aquifer or ambient air.

Ethers are the only chemical group not amenable to vapor extraction treatment which has been identified as a target compound group in both the soil matrix and upper aquifer. Ethers, as well as other SVOCs and residual VOCs, can be biologically degraded under aerobic conditions (refer to Section 4.2.7.2). Hinchee et. al. and Downee et. al. report enhanced biodegradation in the soil matrix as a result of aeration introduced during vapor extraction treatment. Both studies involved the remediation of jet fuel spills at Air Force bases. Levels of carbon dioxide measured during vapor extraction were consistently an order-of-magnitude higher than in the atmosphere, suggesting that significant biological activity was occurring in the subsurface soils. Therefore, biodegradation of SVOCs and residual VOCs could occur as a result of soil vapor extraction.

If required in the future based on monitoring of the performance of the system, in-situ fixation of soils would reduce the mobility of metals.~~, SVOCs and/or PCBs.~~ Figure 4-14 presents a schematic process flow diagram and preliminary design information for in-situ fixation. Refer to Section 3.6.2.5 for a discussion of in-situ fixation~~. The~~ **that shows that the** fixation of metals is a proven technology~~, but the effectiveness of immobilizing PCBs and SVOCs by fixation technologies has yet to be adequately demonstrated.~~ SVOCs~~,~~ **and** PCBs~~, and metals would, therefore, be~~ **are** immobilized in soils by ~~either~~ natural attenuation processes.~~ or fixation techniques.~~

<u>Short-Term Effectiveness</u>

The installation of the groundwater extraction and treatment system would eliminate the migration of contaminants from the Site. As discussed above, VOC removal rates with a vapor extraction system are highest during startup so that a rapid reduction in contaminants in waste and soils would be achieved. The estimated time frame to complete source treatment activities for Alternative 5 is 5 to 20 years. It is assumed for purposes of the cost estimates that groundwater treatment would continue for a 30 year period. A more aggressive pump and treat approach would likely reduce the time frame to reach the maximum achievable level of aquifer contaminant removal.

4.3.6 Alternative 6A - **On-Site** Incineration of Buried Drums; Off-Site Disposal of Miscellaneous Debris; On-Site Incineration of Waste; In-Situ Vapor Extraction of Soils; Groundwater Pumping and Treatment; and Treated Water Discharge to Wetlands Alternative 6B - Same as Alternative 6A Except Waste Would be Treated with Low Temperature Thermal Treatment **and Buried Drums Would be Treated Off-Site by Incineration**

Description

The Site would be dewatered using an extraction system described in Section 4.2.3 so that areas defined as buried waste can be excavated for on-Site thermal treatment (refer to Section 4.3.3). Initially, the groundwater pumping and treatment system would operate at 200 gpm to lower the water level of the Site to elevation 725. Intact buried drums would first be excavated for either on- or off-Site incineration. Miscellaneous debris would be taken off-Site for landfilling. Areas designated as buried waste and PCB-contaminated soils would be excavated for on-Site thermal treatment. Refer to Section 4.3.3 for discussions pertaining to the thermal treatment of buried waste. It is assumed for Alternative 6 that only solid or liquid waste materials would be excavated for on-Site thermal treatment. Soils surrounding the waste or intermixed with the waste would be left in place and treated with the vapor extraction system.

For the purposes of generating a cost estimate for this alternative, buried waste volumes for each source area were determined incorporating both visual observations of buried drum and free waste presence during site investigation activities, as well as a delineation of areas at each sample depth interval with total VOCs in excess of 1% based on data generated during the RI (Refer to "Description" subsection of 4.3.3 for discussion of rationale.) ~~The minimum volume determined using either approach was used to calculate the buried waste volume for this alternative.~~ Based on these determinations, approximately 35,000 cubic yards **to 65,000 cubic yards** (approximately 52,000 tons **to 98,000 tons**) would require on-Site thermal treatment. **An approximate** delineation of areas defined as buried waste is depicted in Figure 4-1. Using 50 ppm total PCBs as the criteria for delineation, approximately 1,000 cubic yards of PCB-contaminated soils would be excavated for thermal treatment. A uniform depth of buried waste presence using surface areas depicted in Figure 4-1 was not assumed in the calculation of volume. The depth requiring excavation for each cross-sectional area was assumed to be the maximum depth meeting one of the buried waste or PCB-contaminated soils criteria outlined above based on sampling intervals used during the RI. Cross-sectional drawings delineating defined areas of buried waste and PCB-contaminated soils at depth will have to be prepared during the final design.

Deed restrictions, fencing and well closures would be required to reduce the potential for human exposure. Long-term monitoring of off-Site contamination migration would also be instituted. Refer to Section 4.3.3 for discussions pertaining to thermal treatment of buried waste.

Groundwater pumping and treatment would be performed to contain off-Site contaminant migration. ~~Following removal of the~~**After dewatering is achieved,** buried waste **would be removed** and ~~their treatment~~**treated** on-Site~~,~~**. Buried drums would be removed and treated on-Site with the buried waste (Alternative 6A) or treated off-Site by incineration (Alternative 6B).** The groundwater pump and treat system would **then** be optimized to determine the most efficient means to remediate the aquifer. Groundwater remediation approaches could include in-situ biological treatment or the placement of injection and withdrawal wells to more aggressively pump and treat the groundwater. Consistent with current U.S. EPA guidance, it may consist of pumping enough to prevent the further migration of contaminants with long term pumping and treating. Groundwater treatment process options which have been retained for detailed analysis include air stripping, biological treatment and UV/oxidation. A comparison of groundwater and surface water treatment process options is presented in Section 4.2.7. At least some of the treated groundwater would be discharged to the wetlands west of the Site or reinjected. ~~Discharging~~ Treated groundwater would **be discharged to the wetlands if required to** prevent dewatering of the wetlands from groundwater pumping. It is anticipated that the groundwater pump and treat system would operate for 30 years.

An in-situ vapor extraction system would be installed following completion of thermal treatment activities. Partial installation of a vapor extraction system could begin following the completion of Site dewatering in areas which are not impacted by buried waste excavation activities. A delineation of areas requiring vapor extraction treatment is depicted in Figure 4-2. Approximately 100,000 cubic yards (150,000 tons) of soil would require on-Site vapor extraction treatment (refer to Section 4.1.2 for basis of soil volume calculation). Refer to Section 4.3.5 for a more detailed discussion of the vapor extraction system.

Because of the large waste and soil volumes requiring treatment, and the significant distances between each of the areas, it has been assumed for cost estimating purposes that four separate vapor extraction systems would be installed. Separate systems would be located in the On-Site Containment Area, the Still Bottoms/Treatment Lagoon Areas, the Off-Site Containment Area and the Kapica-Pazmey Area. Figure 4-15 presents a layout of the proposed extraction system, while Figure 4-16 presents a schematic process flow diagram and preliminary design information for a vapor extraction system.

It may be possible to reduce the aerial extent of the vapor extraction system (and number of vapor extraction systems) by consolidating contaminated soils into one area. The materials handling plan would consist of:

- excavating waste from the off-Site buried waste areas shown in Figure 4-1, thermally treating it and stockpiling the treated material;
- excavating waste from the on-Site buried waste areas shown in Figure 4-1, thermally treating it and stockpiling the treated material;
- excavating contaminated soil from the on-Site areas shown in Figure 4-2 and placing the soil in the buried waste excavation in the off-Site area; and
- backfilling the on-Site waste and contaminated soil excavations with the stockpiled treated material.

The effect of the above is that all contaminated materials from the on-Site areas would be removed or treated so that the on-Site areas will be "clean". All of the contaminated soil would be consolidated in the off-Site areas so that vapor extraction would only need to be conducted off-Site. **Contaminated soils from the on-Site and off-Site areas would be treated as a single area of contamination off-Site.**

Design parameters presented in the case study for the Verona Well Field Superfund Site (Verona Site) located in Battle Creek, Michigan (U.S. EPA, July 1989) serve as the basis for the treatment time frame estimate and extraction well spacings for the ACS Site. The soil conditions and VOC contaminant matrix at the Verona Site were similar to the ACS Site. Maximum individual VOC soil concentrations at the Verona Site ranged up to 1800 ppm (U.S. EPA, July 1989). Approximately 28,000 pounds of VOCs were extracted in 55 days of operation (i.e., an average of approximately 500 pounds/day). Actual design parameters for a vapor extraction system would be determined following the completion of a pilot study.

A grid system of extraction wells, spaced at 75-foot intervals, would be installed in the four areas described above. A 75-foot well spacing would allow each of the wells to serve as either extraction or passive inlet wells in order to provide for maximum operational flexibility. Well placement and screening depths are dependent on the zones of contamination to be treated and localized soil conditions. The extraction well system would be manifolded to a building or shelter housing the vacuum pump and vapor treatment system. Each pump would operate at a vacuum of approximately 5-inches of mercury. Depending on the actual level of vapor emissions and potential implementability issues, the vapor treatment system would either consist of separate carbon adsorption units, separate portable thermal or catalytic treatment units or a larger, centralized thermal or catalytic treatment unit. Since the vapor extraction system would be operated under winter conditions, insulation and heat tracing would have to be provided for portions of the air manifold system installed above the freeze line.

A cover may be placed over unpaved surfaces in the areas to be treated in order to prevent the short-circuiting of air from the surface, which reduces the radius of influence of individual extraction wells. A cover would also reduce rainwater infiltration which could adversely impact vapor extraction treatment efficiencies. Either a plastic liner or soil cover could serve this purpose.

The treatment time frame estimate is based on an assumed average VOC soil concentration of 5,000 ppm (0.5%) following the removal of buried wastes, and an average VOC removal rate of 500 pounds per day (pounds/day) for each area to be treated (i.e., average VOC removal rate reported in Verona case study). A maximum VOC removal rate of 3,500 pounds/day for each treatment area was used to estimate the minimum treatment time frame (refer to Section 4.3.5 for explanation). Based on these VOC removal rates, the estimated time frame to complete source treatment activities for Alternative 6 is 5 to 8 years. This includes a three year time frame to complete dewatering activities and thermal treatment of buried wastes.

Except for the former natural drainage system which received runoff from the Off-Site Containment Area (i.e., sample SD05 in the RI), elevated levels of VOCs and SVOCs were not detected in the remaining drainage ditch and wetlands sediment samples. Low levels of PAHs and phthalates were the predominant contaminants detected in the sediment samples. **Other contaminants detected include 2-butanone manganese, bis (2-ethylhexyl) pthalate, and mercury.** The levels of detected phthalates were within a range which is often typical of naturally occurring background conditions, while the levels of detected PAHs were within a range which is typical of areas proximate to vehicular traffic. Surficial presence of PAHs is often associated with petroleum fuel-containing surface runoff from vehicular traffic sources or leaching from asphalt-based surfaces, such as the roads that bound the Site to the east.

Because of the adverse impacts to the wetlands that would result, the excavation of wetlands and drainage ditch sediments containing these levels of phthalates and PAHs has not been included as part of this alternative. Source removal resulting from the excavation and thermal treatment of buried waste and vapor extraction treatment of soils contaminants would remain in site soils after treatment for Alternatives 2, 3, 4, 5, 6 and 8. Therefore, if soils were excavated under a future exposure scenario, the risks for these alternatives would be greater than for Alternative 7.

The lowest levels of residual contaminants following source treatment would likely be achieved by Alternative 7A in which both waste and soil are excavated and incinerated. Because of its limited history, removal efficiencies for low temperature thermal treatment (Alternative 7B), if selected, cannot be determined without performing a treatability/pilot study; however, they are likely to approach those of 7A for most contaminants. Alternatives 4, 5, 6, 7, and 8 would significantly reduce the primary contaminants present in both waste and contaminated soil at the Site. By removing only buried waste, Alternative 3 would reduce the overall risk by treating the areas of highest contamination. Residual levels of contaminants in the source areas would be higher for Alternative 3 than for Alternatives 4, 5, 6, 7, and 8 because contaminated soils are only addressed by natural flushing or reinjection of groundwater in Alternative 3. Use of a slurry wall and groundwater extraction for containment purposes in Alternative 2 would reduce the migration of contaminants present in the groundwater, but would only marginally reduce the possibility of exposure to contaminated soils by future Site users.

Alternatives 2 thru 8 involve extraction to contain and treat contaminants present in the groundwater off-Site. The continued migration of contaminants in the groundwater would be reduced, which should mitigate future impact to downgradient wetlands, Turkey Creek and residential wells. The potential for lower aquifer impact would still exist for Alternatives 1, 2 and 3 since high levels of residual source contamination would remain.

5.2 Compliance with ARARs

SDWA MCLs have been identified as potential ARARs for groundwater. Contaminants identified in individual groundwater samples exceed corresponding MCLs at some parts of the Site. Alternative 1, the no action alternative, would not comply with these ARARs for the Site. Alternatives 2 thru 8 involve a groundwater pump and treat system which would be used until groundwater cleanup objectives are met.

In Section 3, several ARARs were identified for each of the Alternatives that were considered. With the exception of the no action alternative, all identified ARARs would be met by each of the alternatives.

5.3 Long-Term Effectiveness and Permanence

The RI showed that contaminants have migrated to both the upper and lower aquifers beneath the Site and are migrating away from the Site in groundwater in the upper aquifer. The RI/BRA showed that there is no imminent risk to users of groundwater in the vicinity of the Site. It is possible that there could be risk to groundwater users if the contamination at the Site is allowed to continue to migrate from the Site.

Alternative 1, the no action alternative, does nothing to prevent the continued migration of contaminants to the groundwater and away from the Site. Therefore, in the long term, conditions at the Site would be expected to deteriorate. Eventually, it is possible that contaminants from the Site would impact domestic wells in the vicinity of the Site.

The groundwater pump and treat system which is a part of Alternatives 2 thru 8 would be effective in preventing the migration of contaminants away from the Site and lowering the levels of contaminants in the groundwater over time. Each of the alternatives would be equally effective in preventing the migration of contamination away from the Site. The time required to lower the contaminant levels in on-Site groundwater is dependent on the residual concentrations of contaminants in soils and wastes. However, because off-Site migration is prevented by the groundwater pump and treat system, the length of time required to reach the groundwater cleanup objectives do not make any of the alternatives more or less effective than the others.

The buried waste at the Site does not pose a risk to human health unless there is direct contact, ~~or~~ ingestion **or inhalation** of the waste. Currently, the Site is fenced or the waste is covered with soil or vegetation so there is little potential for ~~either~~ direct contact, ~~or~~ ingestion**, or inhalation**. Alternative 1, the no action alternative, does nothing additional to prevent direct contact, ~~or~~ ingestion**, or inhalation** of waste. Alternative 2 provides additional cover material over the Site, thereby reducing the potential for direct contact, ~~or~~ ingestion, **or inhalation** of waste materials at the Site. The effectiveness of Alternative 2 is dependent on the cover material and slurry wall performing adequately